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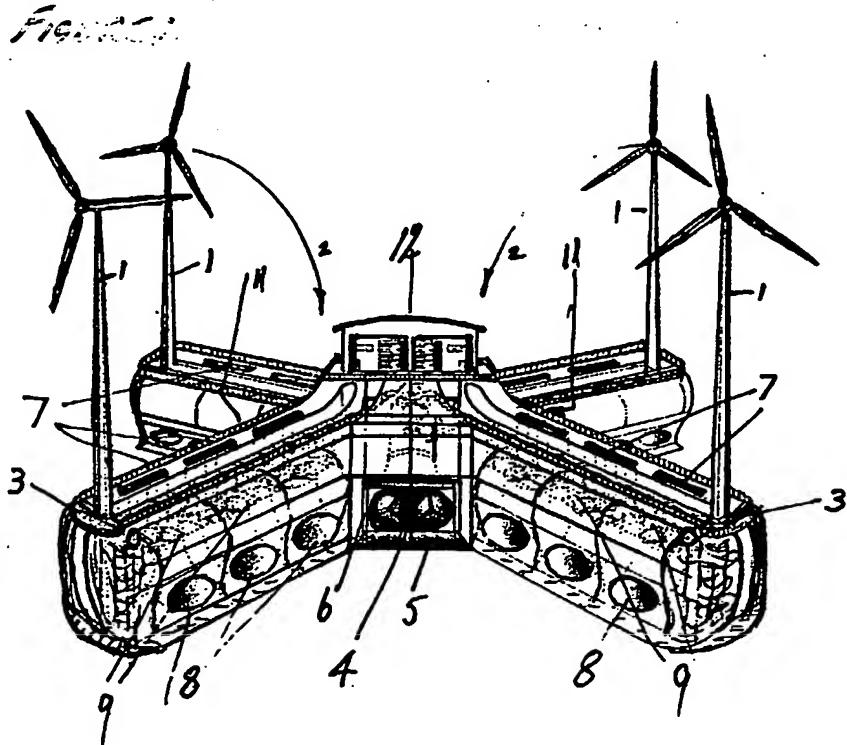
(12) UK Patent Application (19) GB (11) 2 365 385 (13) A

(43) Date of A Publication 20.02.2002

(21) Application No 0019235.1	(51) INT CL ⁷ B63B 38/00, E02B 9/08, F03B 13/12, F03D 9/00
(22) Date of Filing 07.08.2000	(52) UK CL (Edition T) B7A AAAQ E1H HB H601
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(54) Abstract Title
Offshore power generating structure

(57) An offshore structure comprises a cellular concrete base means 1 supporting a number of wind turbines 2, oscillating water column systems 8 and tidal current power generation units 4 adapted to extract wind, wave and tidal current energy from the structures surrounding environment. The base means may be constructed in floating moulds by a process of spraying and laminating concrete before being towed to and then sunk in a designated position. The structure may be shaped such that it directs tidal current flow towards the tidal current power generation units. The structure may incorporate tanks for fish farming and may provide shelter for ships.



The claims were filed later than the filing date but within the period prescribed by Rule 25(1) of the Patents Rules 1995.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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FIGURE.1.

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Total Energy Extractor

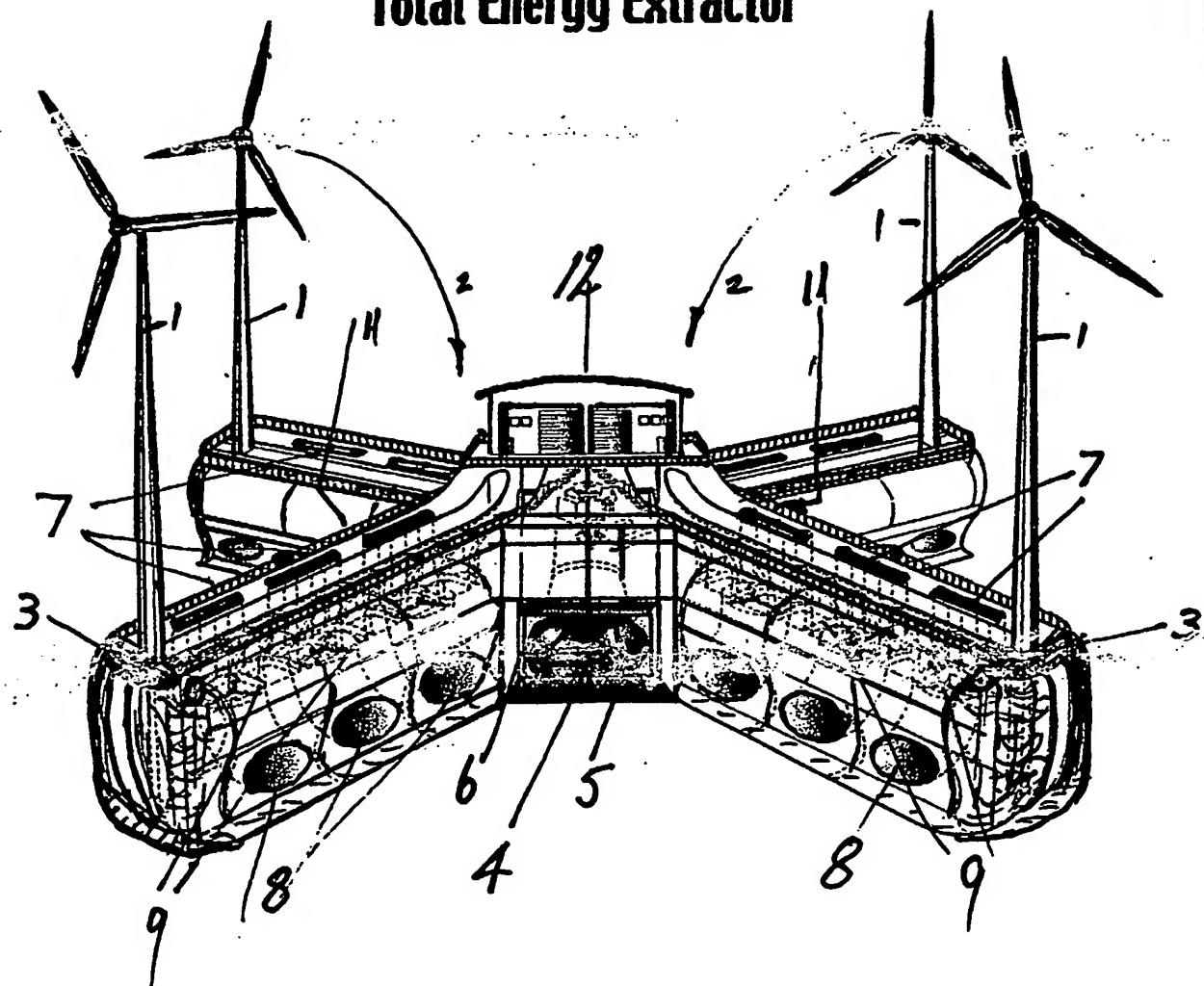


FIGURE.2.

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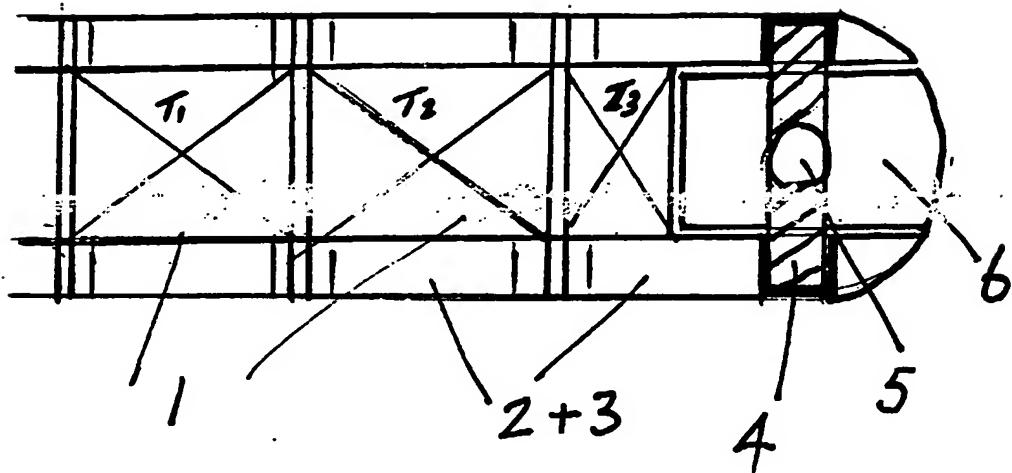
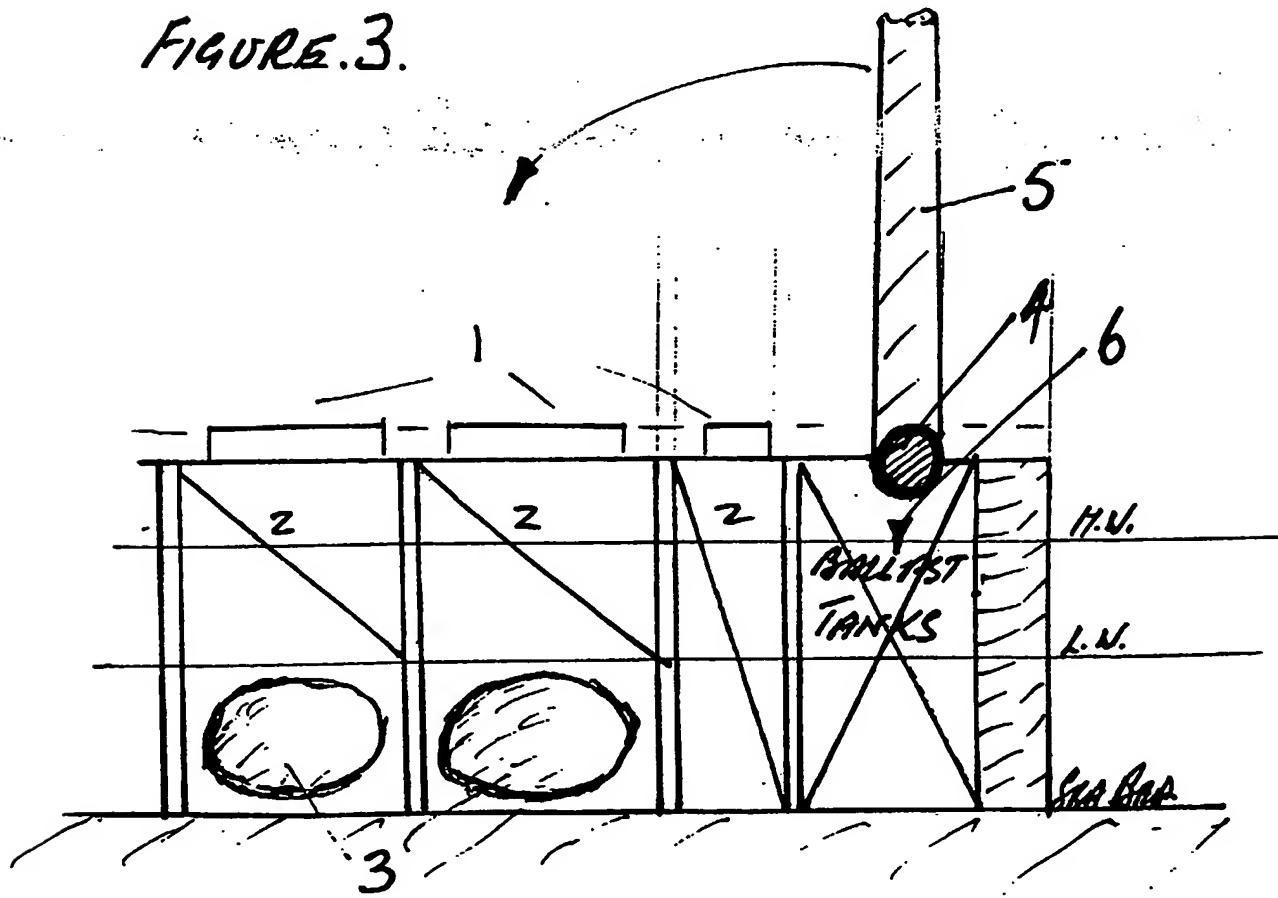


FIGURE.3.



TOTAL ENERGY EXTRACTOR.

This invention relates to the construction and installation of large offshore natural and renewable energy extraction devices.

The generation of power from renewable energy is being promoted by Governments throughout the World to comply with their International Agreements to reduce the effects of global warming.

Energy extraction devices have been designed to extract power from the wind, waves and tidal currents. The present renewable energy market, together with advisory bodies to the Government, and Government Policy, suggests that wind, wave, and tidal current power generation should be installed offshore.

This invention addresses the need to combine several energy extraction devices onto one single support platform and the innovative means of constructing and installing that platform offshore.

The invention comprises a single concrete gravity type structure on which wind, wave, and tidal current generation devices can be grouped and from which they can be effectively maintained and operated.

In the recent past each form of energy generation has been promoted and financed in individual projects. In most cases the capital costs of creating a typical support structure has been approximately half the total project costs. By installing several generation technologies onto one support structure these costs can be spread.

This invention provides the means to construct and deploy a very large concrete structure onto which several energy extraction devices are deployed. Additional revenue earnings from fish farming and marine-culture, together with other activities are carried out on the same structure. The invention incorporates new and innovative design, new construction concept, and new concrete construction materials and techniques. The invention combines the new techniques and concepts with known technologies to extract wave, wind, and tidal current power.

The invention described here for application as an offshore structure may equally be applied to the construction of tidal barrage structures where the same principles may be applied.

The essential features of this invention follow :-

A first feature of the invention is the means to service the major mechanical parts, turbines etc. without removing these parts to the shore.

A second feature of the invention is the provision of additional revenue streams from fish farming and other activities as well as power generation.

A third feature of this invention is the means of construction and assembly which reduces overall costs relative to the size of structure.

A fourth feature of this invention is the ability to install the wind power generator at the (lowered) working platform level and then, to raise the wind power generator to working height position without the use of large and expensive floating cranes.

A fifth feature of this invention is the means and methods to mount the support tower into position on a hinge seat, by floating into position the whole assembly of tower and counter balance caisson. After the tower and counter balance are installed into the hinge seat at the deck

level, then the power unit of a wind generator and nacelle can be attached to the tower top in the lowered position. The tower is designed to rotate about a massive concrete hinge.

The rotation is carried out by controlling the distribution of weight, by pumping ballast about the length of the tower and counter balance caisson to cause rotation and vice versa..

A sixth feature of this invention is the ability to raise and lower the tidal current generator units, from their sea bed operating positions to a servicing position, where the generator units are brought above water level or vice versa. This is carried out and controlled by ballasting or de-ballasting the units, which operate up and down, similarly to floating docks.

A seventh feature of this invention is the facility to direct water flow, relative to the central control part of the device which contains the machinery and tidal current generators. This is done by variable design and disposition of the piers and the orientation of the structure relative to the prevailing current direction. This enables maximum flow to the tidal current generators at the mid point of the device and thus increases the efficiency of the tidal current generators.

An eighth feature of this invention is the ability by design and construction technique, to produce a smooth surfaced dish or funnel shape on the front face of the tidal current generator unit to direct water flow into the machine with minimum friction or turbulence and to enhance the power characteristics and efficiency of the machine by creating a vortex effect.

A ninth feature of this invention is the application of marine growth inhibitors into the smooth concrete surfaces of those parts of the structure where this would benefit their efficiency and this is a facility of the sprayed and laminated concrete construction system employed.

A tenth feature of this invention is provision of multiple tanks and voids to be filled with sea water ballast, compressed air, or sand or other ballast materials either fluid or solid as required.

A eleventh feature of this invention is the construction design which permits the structure to 'grip' into the sea bed of either hard or soft materials to increase friction bearing and thus dispense with the need for anchor piles to prevent movement from the designed settlement position. This is a function of the design and construction system.

A twelfth feature of this invention is the provision of internal tank arrangements which permit the sinking and raising of this structure in principle similar to that of a submarine.

A thirteenth feature of this invention is the provision to lift from the seabed and reposition the structure if necessary.

A fourteenth feature of the invention is the means to construct without the use of massive dry dock facilities by using laminated concrete construction methods as detailed in the patent

Patent No. GB 2218453 Method of Construction.

A fifteenth feature of this invention is the facility to use either open cycle or closed cycle systems of oscillating water column generation from the water line (top) of the four piers.

A sixteenth feature of this invention is the provision of shelter for small vessels on the leeward sides of the structure in severe weather conditions.

A seventeenth feature of this invention is the provision of controlled access points for servicing valves in chambers below the water line. This is carried out by known submarine and caisson control techniques, water tight hatches, pressure chambers etc.

An eighteenth feature of this invention is the provision of travelling cranes over the generators and the fish tanks.

A nineteenth feature of this invention is the creation by design, of bottom feeding grounds for lobster and crab farming activity from the structure.

The invention is further described by reference and explanation to the attached drawings :-

Figure 1. Is a schematic drawing to illustrate the overall concept.

This shows a massive concrete structure - possibly up to 120 metres x 120 metres on plan.

The structure is set in a water depth of approximately 15 to 25 metres.

The widths of the piers might typically 15 to 20 metres.

- 1 The lengths of the four arms or piers is the same as the height of the wind generator towers. In this illustration they are 65 metres long.
- 2 The towers would be approximately 65 metres high for a (typical) 1 MW machine.
- 3 At the ends of each pier is a massive concrete hinge bearing into which the wind tower fits by location of a massive concrete gudgeon pin about which the whole tower and counter balance/caisson rotate. The tower is lifted slightly to relieve bearing pressure and is rotated by pumping ballast into or out of the counter balance caisson and tower casings.
- 4 In the middle of the drawing are shown two x (approximate)1 MW tidal current turbines. These generator turbines operate on both flood and ebb tide flow.
- 5 In front of the current turbines is a sloping skirt to direct water flow into the turbines
- 6 The housings to these turbines are constructed as separate concrete floating docks or caissons which are constructed to 'slot' into their designed positions by way of suitable guides or keyways which guide the separate floating structures into position on / in the main structure. By pumping and ballast controls these generator elements can be raised or lowered to operation level or service level.. or taken away out of service and vice versa.
- 7 Along the length of each pier of the structure at the top level, is a series of tanks which are above the water level, and these provide a 'dead-weight' to stabilise the structure. These are open tanks used for fish farming and other marine culture activities. Between these tanks are the wells type turbines of the OWC wave power generators.
- 8 Along the bottom of the pier structures, both sides, is a 'long bell mouth' which permits the passing wave pressures to be transmitted into the bottom OWC wave generator which works on the closed cycle (Vickers) system.
- 9 At waterline level there are a series of chambers which capture the surface wave energy by the OWC principle, but by way of the open cycle and Wells Turbine type of generator. An alternative would be installation of a Vickers type OWC device at this level.
- 10 In the centre part of the structure, on opposite sides to the tidal current flow machines, are two turbine nais which contain the machines for the closed cycle (bottom) wave energy of the Vickers type of OWC.

11 Access points to land onto the platform are from either or both of the two sides not having the tidal flow generators. A travelling crane facility to off load machinery and parts/stores is positioned at these landing points.

The crane will travel through doors into the building structure. The same, or a similar travelling crane will service the fish tanks and the Wells Turbines when required.

12 A working platform over the tidal current machines and over the wave generator turbines is provided and suitable buildings, part of the structure, are connected in line to the travelling crane for accepting machinery and spare parts from small ships alongside the landing position of the structure.

The building is essentially part of the structure and in addition to machine shop and stores may also enclose work areas for the marine culture activities of the structure and some accommodations for a platform manning crew.

Depending upon the final design size of the structure ie length of the four piers or the number of tidal flow units across the centre of the structure, additional wind generator towers of various type might be installed.

The invention is further described by drawings showing plan and elevations of a typical pier arrangement (one of the four piers of the structure) :-

Figure 2 Plan .

- 1 Fish Tanks
- 2 Chambers for O W C wave power generation.
- 3 Bell mouth access for pressure distribution into closed cycle OWC generator.
- 4 Massive Concrete Hinge for the wind generator / nacelle tower.
- 5 Wind power generator tower and nacelle and rotor blades.
- 6 Caisson and counterweight.

Figure 3 Elevation.

- 1 Fish Tanks.
- 2 Side Chambers.
- 3 Bell mouth.
- 4 Massive concrete hinge.
- 5 Wind power generator tower.
- 6 Caisson / counterweight.

The invention is further described by typical plan and elevation of the central area showing the wave generator turbine area, a power control room, stores and other accommodations for marine culture and working areas and crew accommodations within or upon the structure :-

Figure 4 Plan and Elevation.

NOT YET DRAWN. 

5.

CLAIMS.

1. This invention provides a large concrete cellular structure designed to capture all the available renewable energy sources from a particular marine site.
2. A concrete cellular gravity structure as in claim 1. So configured to extract, wind, wave and tidal current energy from a designated marine site.
3. A concrete cellular marine gravity structure as described in claims 1 and 2 which is manufactured in floating moulds by a process of spraying and laminating concrete.
4. A concrete cellular marine gravity structure which is constructed in a sheltered water site and towed to a designated position and sunk to its designed position.
5. A concrete cellular marine gravity structure which is designed to support four or more wind turbine towers together with wave energy extraction by oscillating water column or other systems and two or more tidal current power generation units .
6. A concrete cellular marine structure upon which the wind turbine towers as described in claim 5 can be hinged about their support axis by de-ballasting their counter weights and lowering the wind towers to service the nacelles in the central work area as shown in figure 1.2 and 3.
7. A concrete cellular marine gravity structure which incorporates tanks for fish farming and for ship shelter and other marine revenue activities from the single structure.
8. A concrete cellular marine structure which is configured to generate energy from two or more tidal current turbines or oscillating hydro vanes about the centre of the structure in which the current flow is directed by the shape and design of the structure.
9. A concrete cellular marine structure in which the current energy extractor devices as described in claim 8 can be withdrawn from the water for servicing by the use of floating dock principles incorporated into the structure as shown in figure 1
10. A concrete cellular marine gravity structure which incorporates more than one form of wave energy extraction.
11. A concrete cellular marine gravity structure which incorporates tanks above waterline level which serve as fish breeding tanks and which add substantial dead-weight to the structure.
12. A concrete cellular marine gravity structure to extract wind, wave and current energy and which provides accommodations to service all the major power generating plant for wind , wave, and current turbines without the need for total removal of the equipment and without the use or substantial alongside marine cranes.



Application No: GB 0019235.1
Claims searched: All

Examiner: Richard Collins
Date of search: 3 December 2001

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GE, EP, WO & US patent specifications, in:

UK Cl (Ed.S): B7A AAAQ; E1H HB; F1S S28A, S28B1, S28B2, S28BX; F1T TA, TDC.

Int Cl (Ed. 7): B63B 35/00, 35/44, 38/00; E02B 9/08, 17/00, 17/02; F03B 13/12; F03D 9/00.

Other: Online EPODOC, JAPIO, WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2335006 A (EDWARDS) see figure 1 and related description.	1 at least
X	WO 00/19093 A1 (HA) see figures and abstract.	1 at least
X	DE 3622285 A1 (MESCHENMOSER) see figures and abstract.	1 at least
X	DE 2923212 A1 (MARX) see figures and abstract.	1 at least
X	FR 2288029 A1 (RINALDI) see abstract.	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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